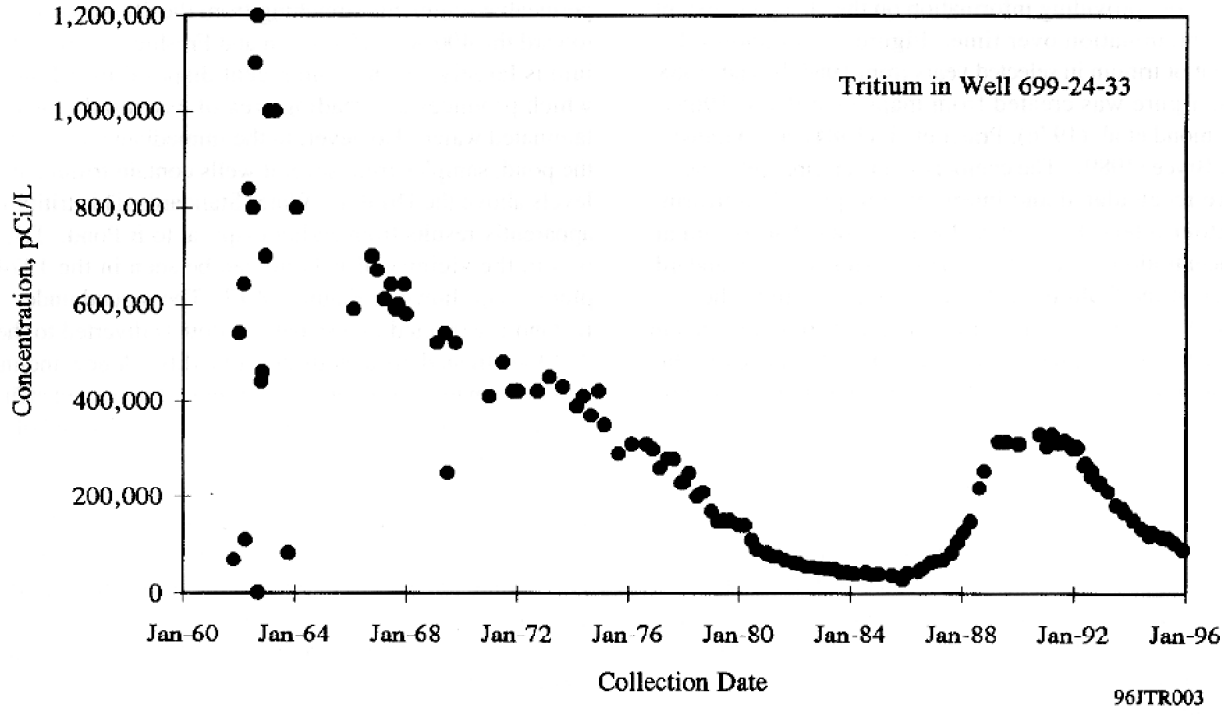

Figure 4.8.15. Tritium Concentrations in Well 699-24-33, 1961 Through 1995

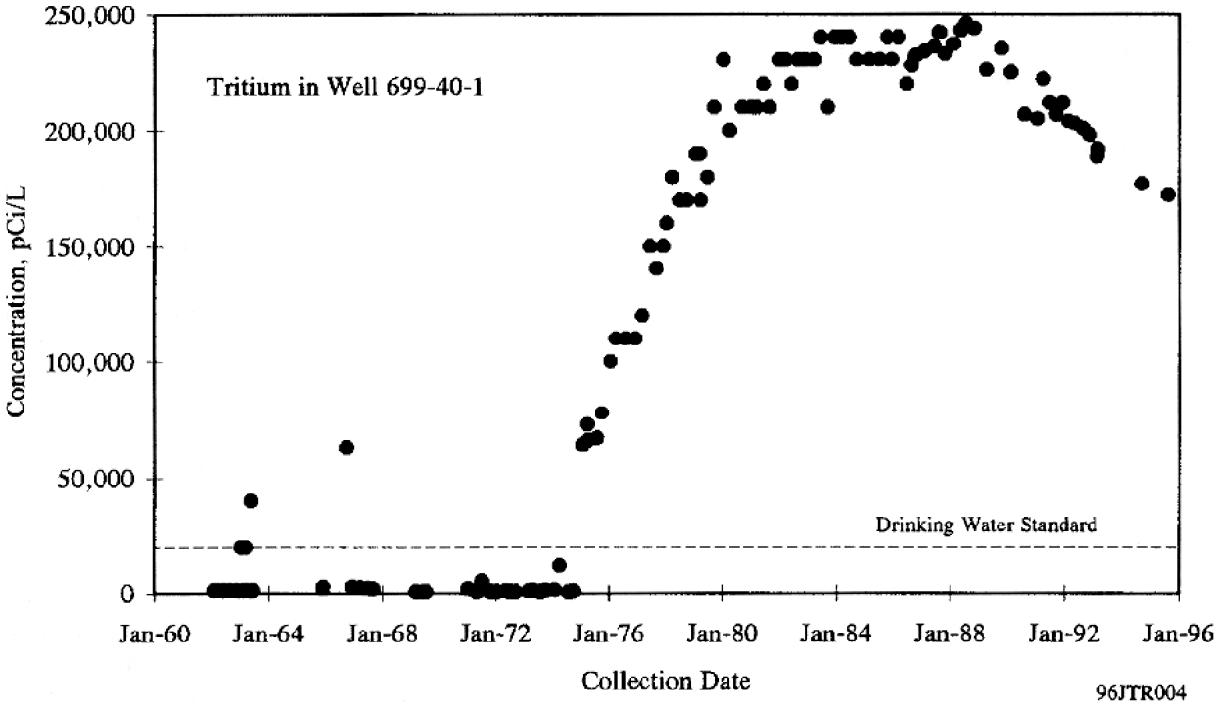

Figure 4.8.16. Tritium Concentrations in Well 699-40-1, 1962 Through 1995

operation, providing information on the change in extent of contamination over time. Figure 4.8.17 shows the extent of tritium in selected years from 1964 through 1988. This figure was created from maps in Wilson (1965), Raymond et al. (1976), Prater et al. (1984), and Jaquish and Bryce (1989). The contours in the original references were recalculated and interpreted to provide uniform contour intervals. Figure 4.8.17 shows that tritium at concentrations greater than the Drinking Water Standard reached the Columbia River in approximately the mid-1970s. Variations in the extent of tritium mapped in the 100 Areas appear to result from differences in the monitoring network and different interpretations of results between investigators.

The eastern portion of the tritium plume continues to move to the east-southeast and discharge into the Columbia River. Figure 4.8.18 shows the trend of tritium concentrations in well 699-S19-E13, located just north of the 300 Area. In recent years, this well has shown a general increase in tritium, reaching a maximum value of 13,300 pCi/L in November 1995, the same as the 1994 maximum value. The tritium plume extends into the 300 Area, where concentrations in some wells (e.g., well 399-2-2) are greater than half the Drinking Water Standard (Figure 4.8.19). The tritium plume is not expected to impact the North Richland Wellfield because of the influence on ground-water flow from the Yakima River and recharge from infiltration ponds at the North Richland Wellfield (Figure 4.8.20). The Yakima River is at a higher elevation and recharges the ground water in this area (Newcomer et al. 1991). As a result, ground water flows from west to east (Figure 4.8.20), minimizing the southward movement of the contaminant plume. Recharge ponds at the North Richland Wellfield are supplied with Columbia River water, which infiltrates to the ground water. The amount of recharge water exceeds the amount pumped at the wellfield by a factor of approximately 2:1, resulting in ground-water flow away from the wellfield. This further ensures that the Site ground water will not reach the wellfield. Ongoing monitoring is being performed by the Ground-Water Surveillance Program in order to confirm this interpretation.

The configuration of the western portion of the tritium plume shown in Figure 4.8.12 closely matches previous predictions of the direction of contaminant movement from the 200-East Area (Freshley and Graham 1988). Movement is forced to the south by the flow originating at the ground-water mound beneath B Pond. Flow to the southeast also appears to be controlled by a zone of highly permeable sediments stretching from the 200-East Area toward the 400 Area (Jacobson and Freshley 1990). Tritium is largely absent from recent disposal to B Pond, which produces a spreading area of essentially uncontaminated water. However, in the immediate vicinity of the pond, samples from several wells contain tritium at levels above the Drinking Water Standard. This tritium apparently results from earlier disposal to B Pond. Tritium in the vicinity of B Pond can be seen in the 1974 plume map shown in Figure 4.8.17. The mound under B Pond is expected to dissipate as flow is diverted to the 200-East treated effluent disposal facility. A new mound will presumably form farther east under the treated effluent disposal facility as long as it is used for disposal of Site effluent.

Tritium is also found at levels above the Drinking Water Standard in the northwestern part of the 200-East Area. This plume appears to extend to the north through the gap between Gable Mountain and Gable Butte, indicating a divide in ground-water flow direction across the 200-East Area.

The extent of tritium plumes in and around the 200-West Area is also consistent with previous observations. Tritium from sources near the Reduction-Oxidation Plant forms the most extensive and highest concentration plume in the 200-West Area. This plume extends into the 600 Area east of the 200-West Area. The Reduction-Oxidation Plant is located in the southeastern part of the 200-West Area and operated from 1951 through 1967. No wells in the 200-West Area showed tritium levels in excess of the DOE Derived Concentration Guide during 1995. Samples from the well in the 200-West Area with the highest tritium concentrations, well 299-W22-9, contained a maximum of 1,050,000 pCi/L of tritium. The declining concentrations in this well are shown in Figure 4.8.21. The movement of ground water in the 200-West Area is slow because the Ringold sediments have low permeability. Dissipation of the plumes in the 200-West Area is also slow as a result of declining gradients since the closure of U Pond in 1984.

A smaller area of tritium contamination is found in the north-central part of the 200-West Area in the vicinity of the WMA-TY-TX single-shell high-level waste tanks (Figure 4.8.11) and disposal facilities, which received liquid waste from T-Plant operations. This plume extends northeast past the boundary of the 200-West Area. Although a number of the single-shell waste tanks in this area are known or assumed to have leaked, it has not

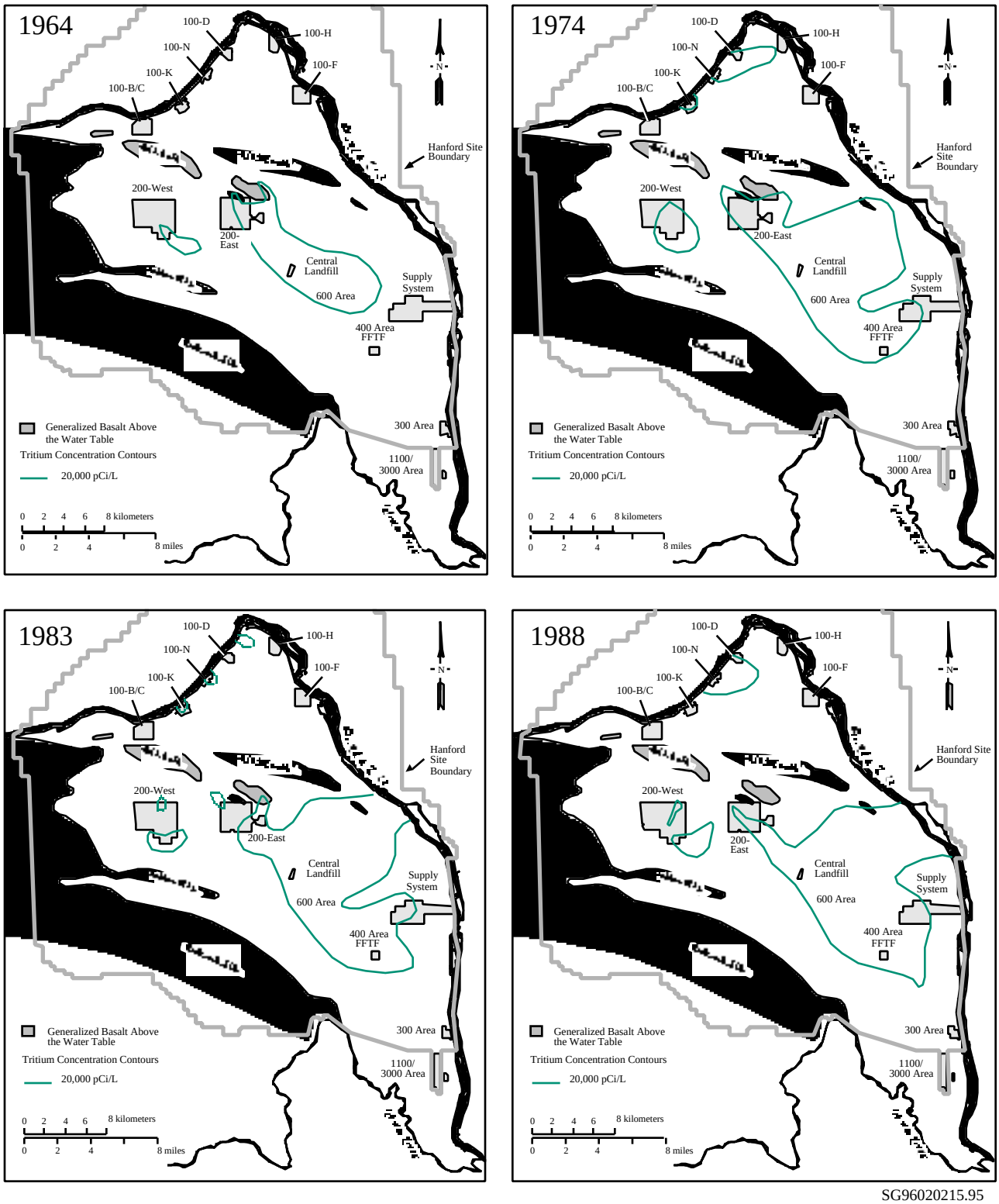

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Figure 4.8.17. Historical Tritium Concentrations on the Hanford Site

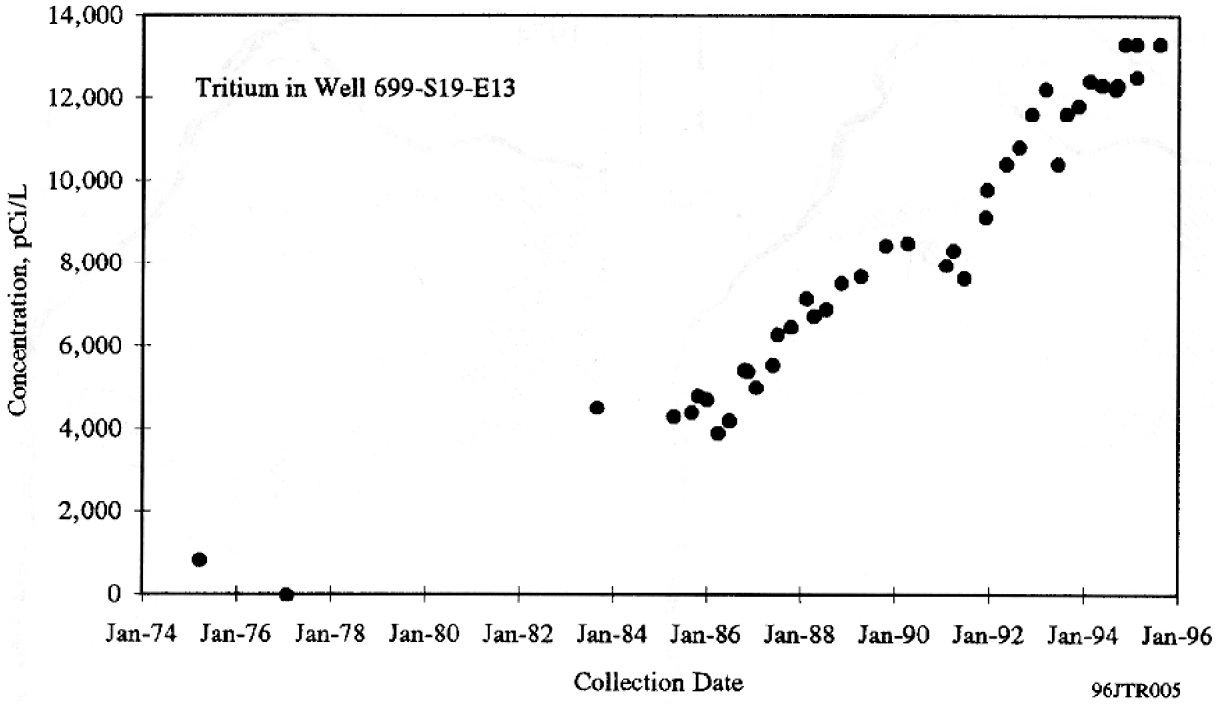

Figure 4.8.18. Tritium Concentrations in Well 699-S19-E13, 1975 Through 1995

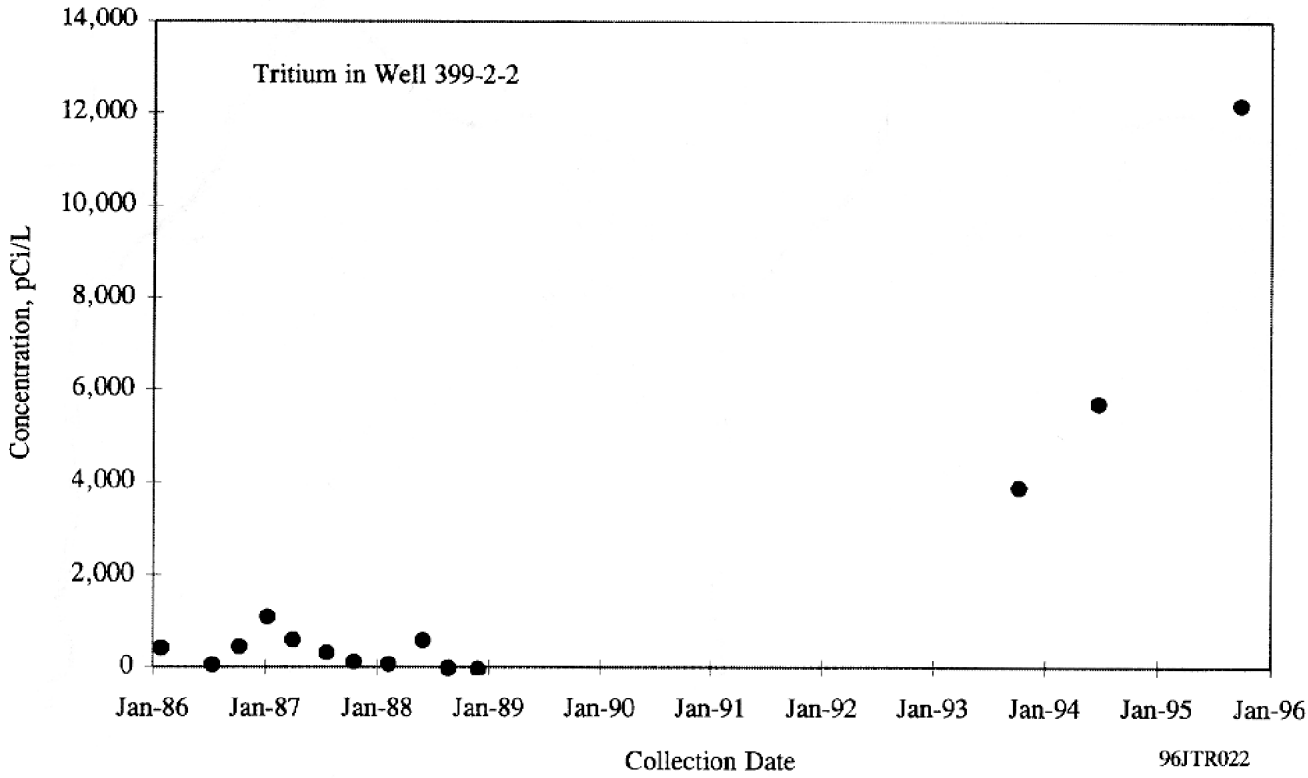

Figure 4.8.19. Tritium Concentrations in Well 399-2-2, 1986 Through 1995

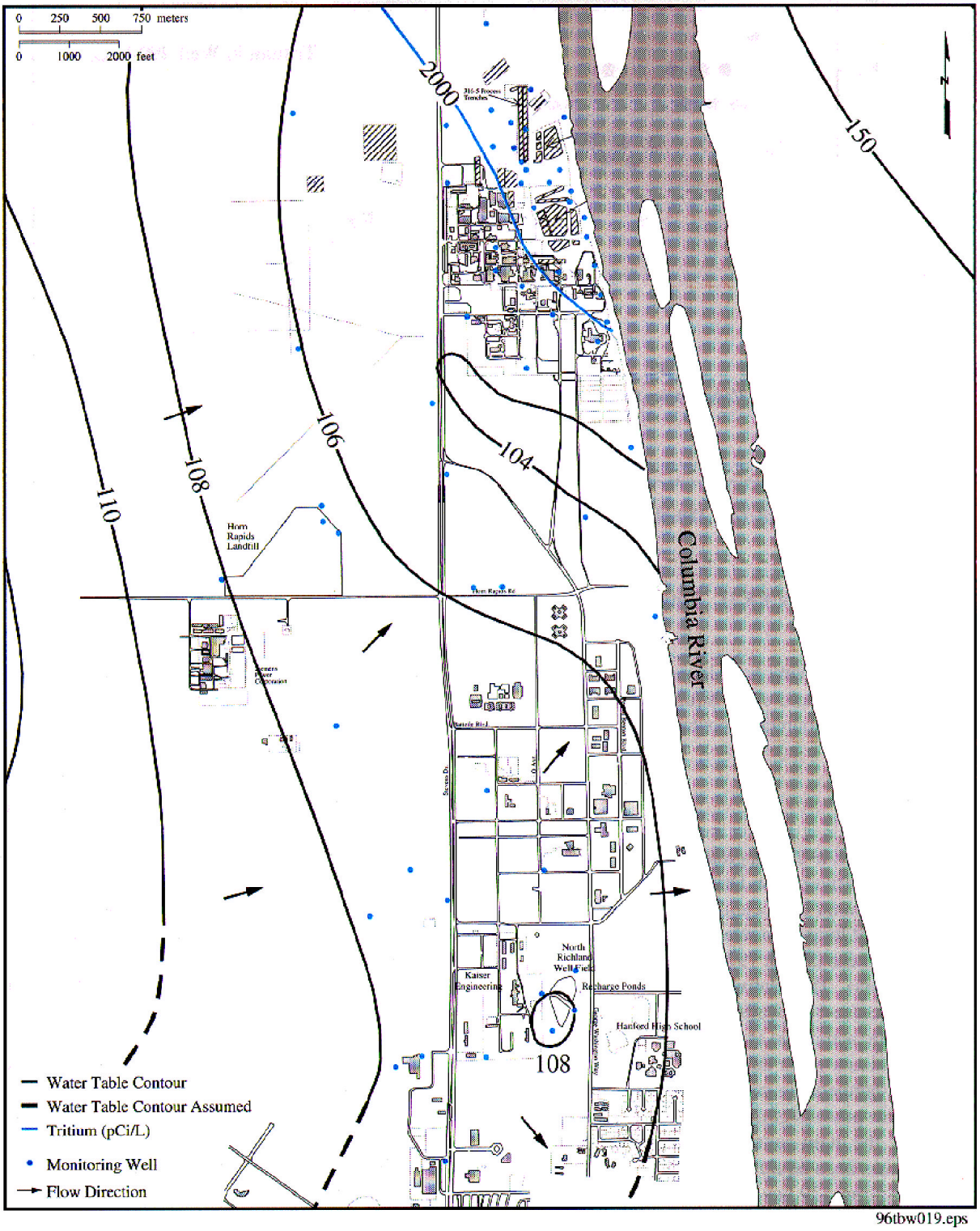

Figure 4.8.20. Tritium Distribution and Ground-Water Flow Near the 300 Area, 1995

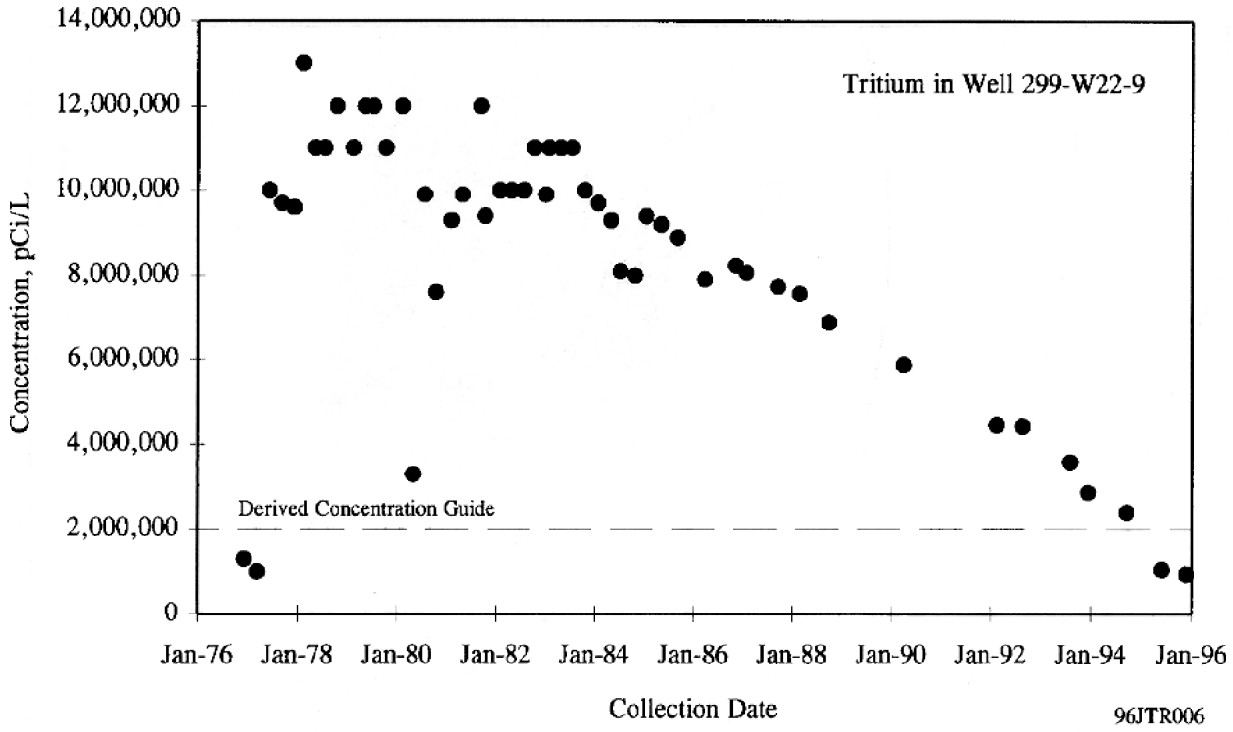

Figure 4.8.21. Tritium Concentrations in Well 299-W22-9, 1976 Through 1995

been determined if the leaks have impacted ground water or if the nearby cribs and other liquid waste disposal facilities are the only sources of contaminants, including tritium, in this area.

Iodine-129

The presence of iodine-129 in ground water is significant because of its relatively low Drinking Water Standard (1 pCi/L), its potential for accumulation in the environment as a result of long-term releases from nuclear fuel reprocessing facilities (Soldat 1976), and its long half-life (16,000,000 years). The relatively low fission yield for production of iodine-129 combined with its long half-life limits its specific activity in Hanford wastes. Iodine-129 may be released as a vapor during fuel dissolution and other elevated-temperature processes and thus may be associated with process condensate wastes. At the Hanford Site, the main contributor of iodine-129 to ground water has been liquid discharges to cribs in the 200 Areas. Iodine-129 has essentially the same high mobility in ground water as tritium and nitrate. The highest concentrations observed onsite are downgradient from the Reduction-Oxidation Plant in the 200-West Area and the Plutonium-Uranium Extraction Plant in the 200-East Area. Iodine-129 contamination extends into the 600 Area as shown in Figure 4.8.22. No iodine-129 samples were above the DOE Derived Concentration Guide of 500 pCi/L in 1995.

The highest iodine-129 concentrations in the 200-East Area are in the northwest near the 216-BY Cribs and in the southeast near the Plutonium-Uranium Extraction Plant. The maximum concentration of iodine-129 detected in 1995 in the 200-East Area was 13.2 pCi/L in well 299-E24-17. This well is located south of the Plutonium-Uranium Extraction Plant near the 216-A-10 Crib. The iodine-129 plume from the Plutonium-Uranium Extraction Plant area extends southeast into the 600 Area and appears coincident with the nitrate and tritium plumes. The iodine-129 plume appears smaller than the tritium plume because of the lower initial concentration of iodine-129. Iodine-129 can be detected as far as the Columbia River, but at levels below the Drinking Water Standard. Current data indicate that iodine-129 at levels above the Drinking Water Standard is approaching the Columbia River (Figure 4.8.22). The iodine-129 plume likely had the same sources as the nitrate and tritium plumes. Iodine-129 is also present in ground water at levels above the Drinking Water Standard in the northwestern 200-East Area near the BY Cribs and the WMA-B-BX-BY high-level waste, single-shell

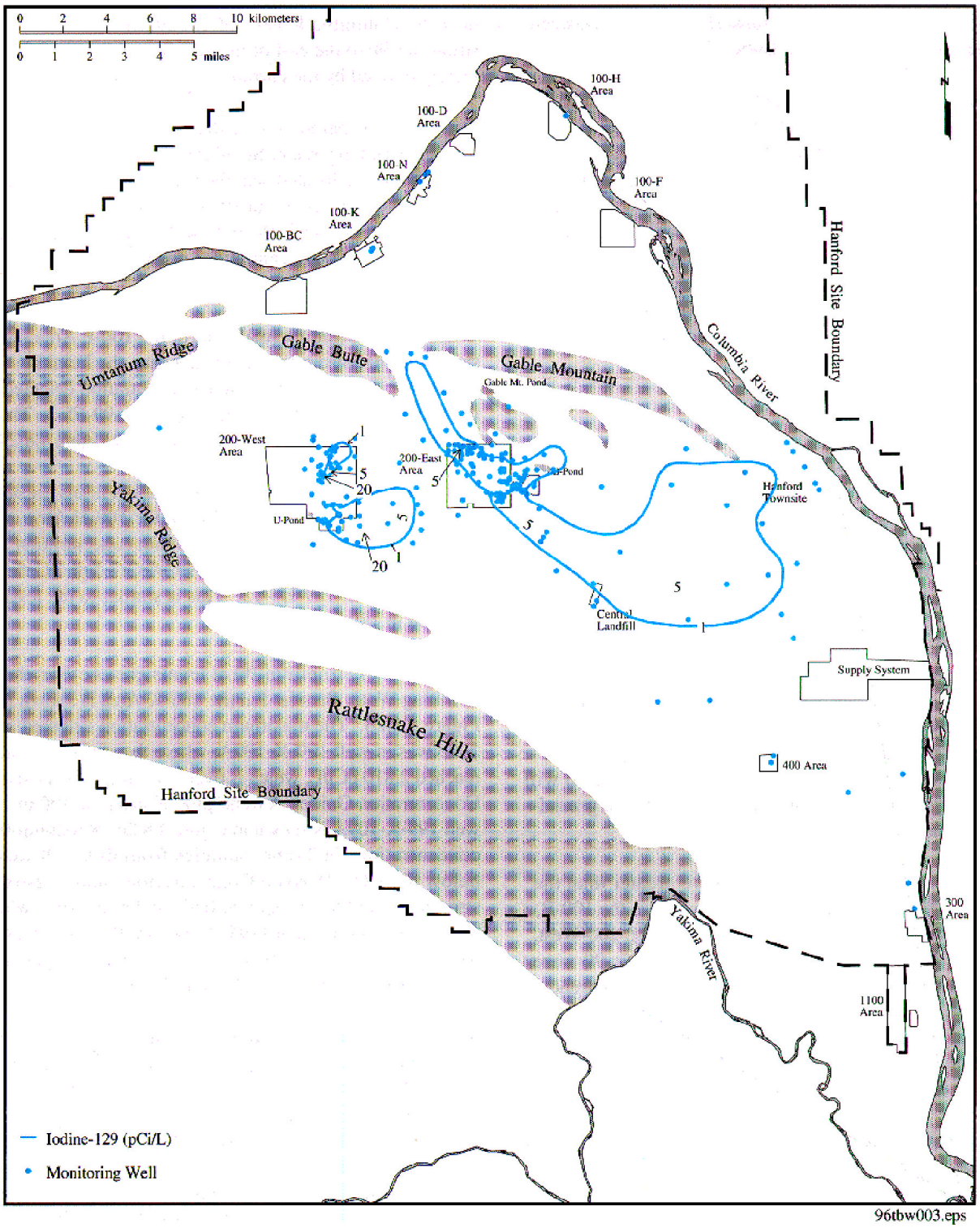

Figure 4.8.22. Distribution of Iodine-129 in the Unconfined Aquifer, 1995

tanks. This plume extends northwest into the gap between Gable Mountain and Gable Butte.

The highest iodine-129 concentration observed in 1995 in Hanford ground water was 74.2 pCi/L in well 299-W22-9, in the southern part of the 200-West Area near the Reduction-Oxidation Plant. This plume is essentially coincident with the nitrate and tritium plumes although there appears to be a contribution from cribs to the north, near the U Plant. A second iodine-129 plume originates near the WMA-T single-shell tank farm and nearby disposal facilities and extends northeast toward T Plant, coincident with the technetium-99 and tritium plume in this area.

Strontium-90

Strontium-90 was produced as a high-yield fission product and was present in waste streams associated with fuel processing. Reactor operations also may have resulted in the release of some strontium-90 associated with fuel element breaches. Strontium-90 mobility in Hanford ground water is reduced by adsorption onto sediment particles. Because this adsorption is much weaker than for cesium-137, cobalt-60, and plutonium isotopes, the strontium-90 is still moderately mobile. Because of sorption, a significant portion of the strontium-90 in the subsurface is not in solution. If ground-water concentrations of strontium-90 decrease due to natural processes or remediation activities, the sorbed strontium-90 will desorb and remobilize. This limits the options for groundwater remediation.

Concentrations of strontium-90 were greater than the 8-pCi/L Drinking Water Standard in wells in the 100-B, 100-D, 100-F, 100-H, 100-K, 100-N, 200-East, 200-West, and 600 Areas. Concentrations of strontium-90 were greater than the 1,000-pCi/L DOE Derived Concentration Guide in the 100-K, 100-N and 200-East Areas. This is the first year on record in which strontium-90 values above the DOE Derived Concentration Guide were detected in the 100-K Area.

Strontium-90 in the 100 Areas. Strontium-90 is found at levels greater than the Drinking Water Standard in the 100-B Area and extends into the 600 Area to the east. The maximum concentration detected in 1995 was 48.4 pCi/L in a sample from monitoring well 199-B3-46. The extent of strontium-90 greater than the Drinking Water Standard in the 100-B Area is shown in Figure 4.8.23. The sources for the strontium-90 appear to be liquid waste disposal sites near the B Reactor and liquid overflow trenches near the Columbia River (DOE 1993a). The extent of strontium-90 to the east of the 100-B Area is not completely defined by the current monitoring network.

Strontium-90 continues to be detected at levels greater than the Drinking Water Standard in the 100-D Area in well 199-D5-12, located near the D reactor building. The maximum concentration in 1995 was 38.7 pCi/L, similar to that in 1994. This is the only well in the 100-D Area with strontium-90 concentrations greater than the Drinking Water Standard.

Ground water within a small part of the 100-F Area has strontium-90 concentrations greater than the Drinking Water Standard. The maximum concentration detected in 1995 was 136 pCi/L in monitoring well 199-F5-3. The 100-F Area strontium-90 plume is shown in Figure 4.8.24.

The extent of strontium-90 contamination at levels greater than the Drinking Water Standard in the 100-H Area is shown in Figure 4.8.25. The maximum concentration detected in the 100-H Area in 1995 was 27.7 pCi/L in monitoring well 199-H4-13. This is similar to the level detected in 1994.

The extent of strontium-90 at levels greater than the Drinking Water Standard in the 100-K Area is shown in Figure 4.8.26. The maximum concentration detected in 1995 was in well 199-K-109A, where the concentration reached 2,810 pCi/L, which is over twice the DOE Derived Concentration Guide. A trend plot of strontium-90 in well 199-K-109A is shown in Figure 4.8.26. Strontium-90 concentrations in 3 other samples from this well were below the DOE Derived Concentration Guide. This strontium-90 plume was identified for the first time when this well was installed in 1994. Strontium-90 is also found near the K-West reactor building, and an extensive plume continues to be found near the liquid waste trench.

Strontium-90 was detected in concentrations greater than the 1,000 pCi/L DOE Derived Concentration Guide in the 100-N Area in 1995. The maximum level detected was 9,180 pCi/L in well 199-N-67. This well is located between the 1301-N Liquid Waste Disposal Facility and the Columbia River. Concentrations of strontium-90 in this well generally declined from 1989 through 1994 but increased in 1995 to over one third of the 1989 level (Figure 4.8.26). The distribution of strontium-90 in the 100-N Area is shown in Figure 4.8.26. Strontium-90 discharges to the Columbia River in the 100-N Area through springs along the shoreline. Springs are sampled as part of the surface water surveillance and near-facility

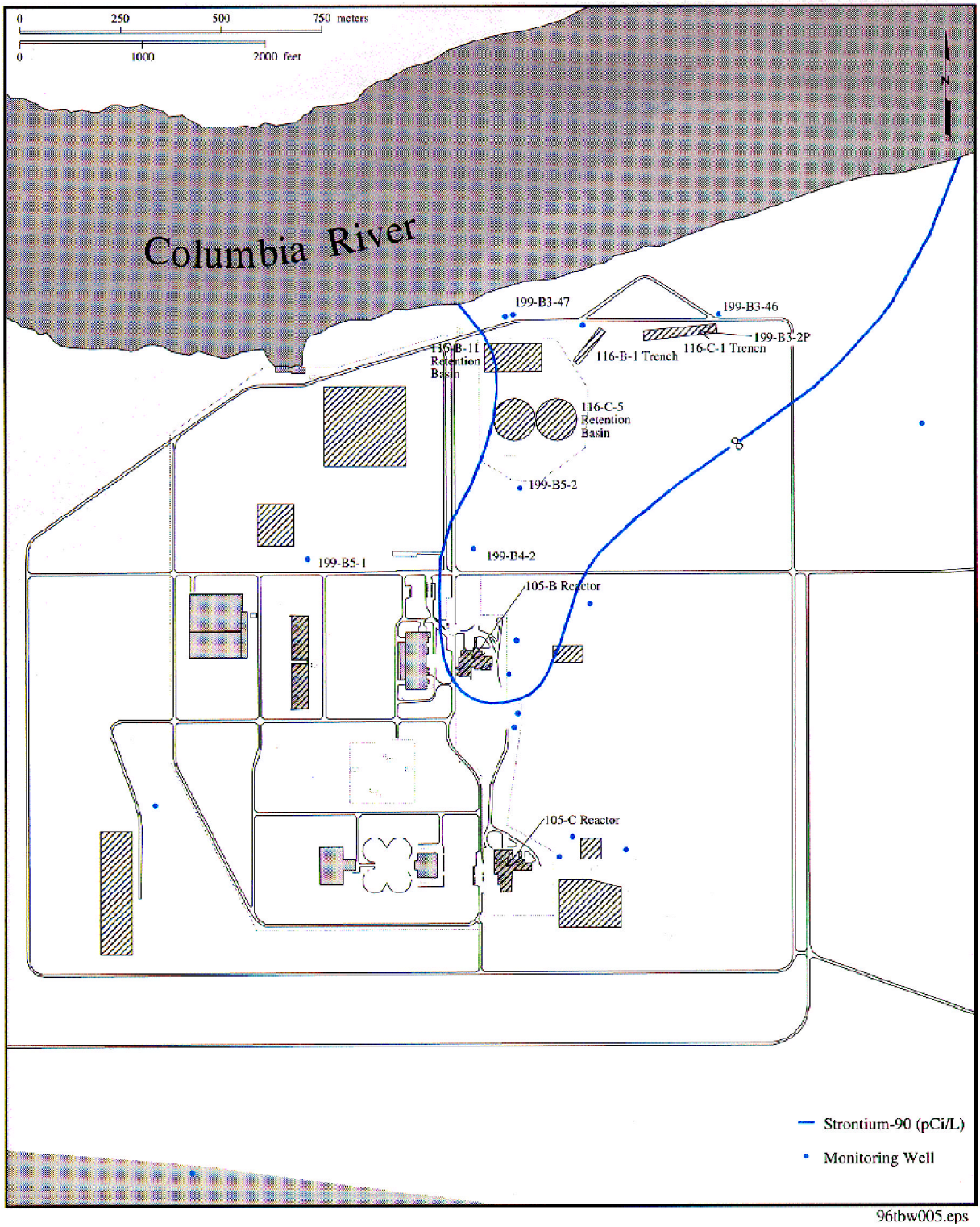

Figure 4.8.23. Concentrations of Strontium-90 in the Unconfined Aquifer in the 100-B Area, 1995

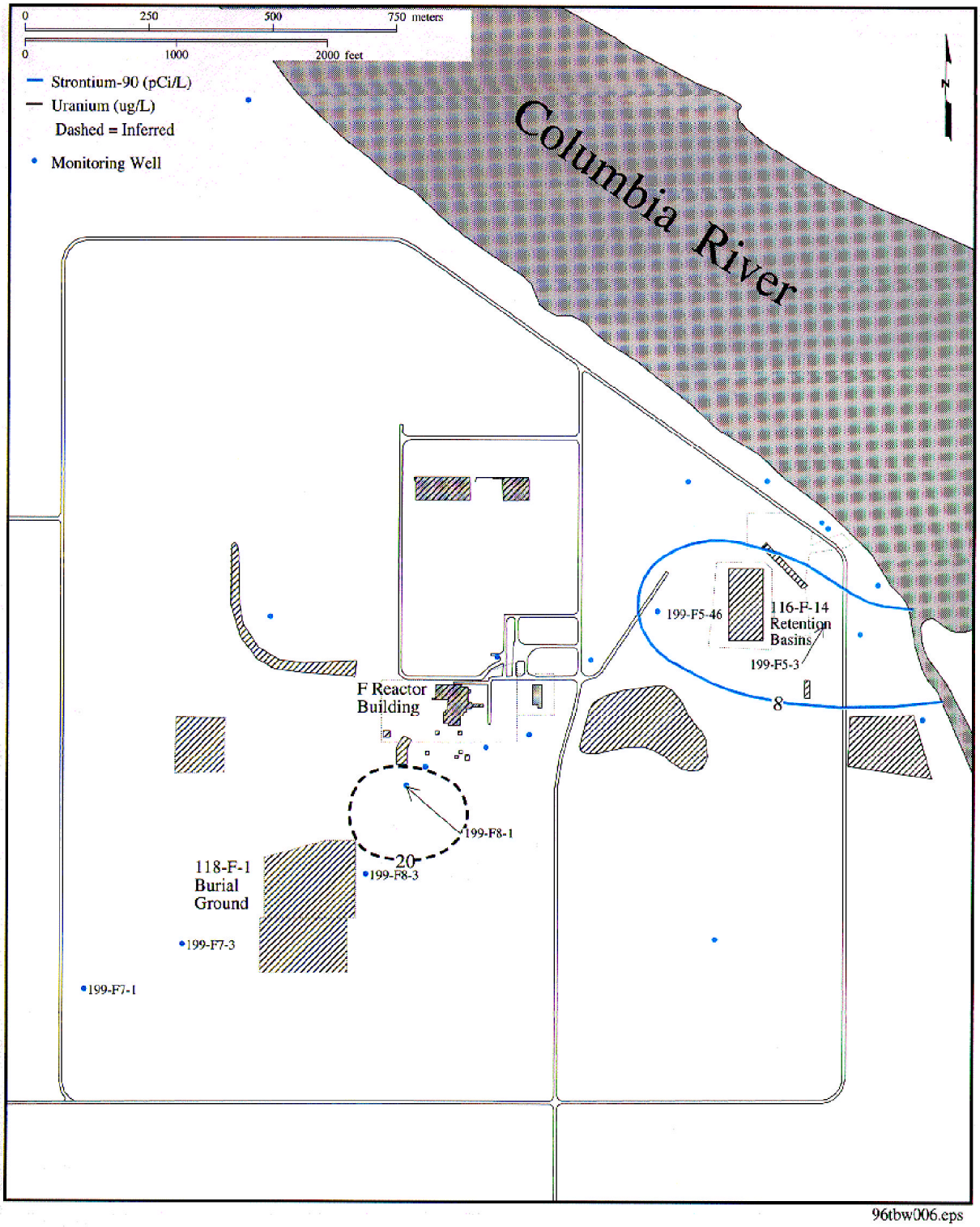

Figure 4.8.24. Concentrations of Strontium-90 and Uranium in the Unconfined Aquifer in the 100-F Area, 1995